A STUDY OF IMPLEMENTATION OF THE INTERMEDIATE SCIENCE CURRICULUM STUDY IN KANSAS

by

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Chapter 1

INTRODUCTION

A Beginning Science Curriculum

The nature of science has always been one of improvement or constant updating. New developments and findings in science technology and consumer science have consistently been a part of society. Not immune to this changing characteristic of science is the educating of young people in our schools in the area of science. The science programs of the past coupled with the ever-increasing number of innovative programs of the present, provide schools with a wide variety of choice to select from for their science curriculum. Among these new programs developed since the middle 1960's that were offered in competition, was the Intermediate Science Curriculum Study (ISCS). ISCS is an individualized, activity-oriented, laboratory science program tailored for the junior high or middle schools.

In the middle 1960's, the ISCS program had its inception at Florida State University. More than two hundred fifty talented writers, scientists, science educators, junior high science teachers, administrators, and others have contributed to the effort. An advisory committee of distinguished scientists,

teachers, and educational specialists have helped formulate and provide guidance. Every part of the country and virtually every type of institution that might have relevant competencies and an interest in the junior high school program was represented among the writers (Burkman, 1974, pp. 53-59). Financial support was provided by the U.S. Office of Education and the National Science Foundation.

In the school year 1965-66, the very first set of ISCS materials were tested by one-thousand Florida junior high school students (ISCS Newsletter 1, 1967, p. 8). The following school year field trials began with over five thousand students and fifty teachers in the seventh grade program alone. In the succeeding years, new try-out centers were established and the eighth and ninth grade programs began. In the 1969-70 school year, over seventy thousand students in 22 states and the Phillipines were involved with ISCS. By January 1, 1973, every state in the nation had used the ISCS textbook. Textbook sales for the three level program sold over one million copies and continued to climb. In the school year of 1972-73, better than ten percent of the United States seventh grade science classrooms then used ISCS textbooks (ISCS Newsletter 11, 1973, p.1). The 1974-75 school year prompted Ernest Burkman, project director for ISCS to state:

> Today (1974) hundreds of thousands of junior high level students in this country and abroad are being taught via the institutional system devised by ISCS, and many indications suggest that the numbers will grow substantially in the years to come (Burkman, 1974, pp. 53-59).

In 1977, the Science Education Data book reported that Probing the Natural World, Silver Burdett's text for ISCS was the second most widely used text in seventh and eighth grade. The percentage of all the science classes using ISCS approached seven percent.

The Problem

New knowledge obtained by research scientists is usually thought of as very important to our society. Perhaps even more important but not as well acclaimed is the publication of new ways of delivering both old and new knowledge to students and the public. In the last twenty years, there has been many developments in secondary school science. These recent educational programs in physics, biology, and chemistry are now being used in many of our schools in hopes that they will improve science education. However, the problem becomes very evident that with this high influx of new educational knowledge or programs that there is a lack of communication for the "use and development of techniques for accurate surveying of actual teaching practices and the actual use of new curriculum materials and perhaps more importantly, appropriate evaluations of these new techniques and materials" (Lee, 1967, p. 9).

To complicate the matter further, most of the recent courses tend to emphasize a laboratory approach to science

(Marshall and Burkman, 1966, p. 10). Furthermore, new curriculum studies have now reached a stage of maturity and are "on their own." The materials are accepted and being used now by many teachers that were not involved with the initial development. Existing in this dilemma is a gap that needs some analysis and evaluation in terms of the current use of these materials by teachers and students. Research should try to bridge the gap between the developments and the uses of new materials that could structure teaching programs for optimum effectiveness.

Among the science curriculum projects, ISCS has some unique components. Like the others, it provides focus on science processes and concepts, laboratory based instruction and hands on learning experiences. But ISCS adds a self paced program in which the textbook and not the teacher directs the student's examination of science content. Further, the teacher, being freed from the role of information giver, is available for one-on-one contacts with students. In the past, all students covered the same content, but in ISCS, nearly half of the content is made up of Excursions---remedial, enrichment, and techniques---which students can choose. In order to give the ISCS student more responsibility for his/her learning, ISCS authors have designed self evaluation

materials keyed to program objectives, thus providing the ISCS student with feedback about how well he/she has mastered the course content.

Statement of the Problem

The problem of this study is to examine the nature and extent of ISCS implementation in Kansas. This study will examine how Kansas ISCS teachers are using the various components of the program and assess the overall picture of implementation in relation to basic demographic data and training to use the program, years of use of the program, and perceived level of support by the district and community.

Significance of the Problem

Responsibility for the success of any new adoption program rests heavily on the teachers using the program. The National Science Foundation (NSF) spent fourteen million dollars to train eighteen hundred science teachers in 1972. Of these, eight hundred concentrated in ISCS at nine different colleges that were largely or totally centered on ISCS (ISCS Newsletter 10, 1972, p. 9). To further revise and tailor the ISCS program to specific schools across the nation, a commitment on an individual basis between school and the college was an integral part of each ISCS training project. This would allow the NSF funds to be put to "best" use.

In the last five to six years there seems to have been a decline in the number of new ISCS adoptions. The exact cause of this is still under speculation. Two possible causes as mentioned in a study by Glenn Markle and Thaddeus Fowler on Whatever Happened to ISCS (1983, p.2), are cost and insufficient training of would-be ISCS teachers. However, ISCS will still be very much in the future as shown by the amount of use of ISCS textbooks. A small permanent staff housed on the Florida State campus and associated with the College of Education continues to give assistance in revising and upgrading the ISCS project. Schools tend not to change very quickly once a program is adopted and with the significant number of schools still using the program, ISCS is expected to continue to influence junior high school science classes.

Instrumentation

The Research and Development Center at the University of Texas at Austin has spent the last ten years developing strategies for assessing implementation of new programs in schools. Innovation Configuration (IC) is a construct developed to assess how teachers operationalize various components of new programs they are implementing. This strategy involves developing a two way matrix of the components of the innovation and the various ways that each component is used (Heck, Stiegelbauer, Hall, Loucks, 1981, p. 1).

The ISCS Innovation Configuration Checklist has been carefully developed using the strategies suggested by the Texas Research and Development Center. This matrix has been converted into a checklist involving eleven items which will enable ISCS science teachers to check how they are using each component.

Limitations of the Study

1. Since the population was limited to Kansas, the conclusions can only be generalized to other states with similar conditions.

2. This study is limited by the assumption that the teachers' actual classroom procedures are reflected in their responses to the instrument.

Definitions

Scientific literacy - Scientific literacy should give the student the ability to read and write about science to a certain degree of sophistication (Haney and Sorenson, 1977, pp. 43-44).

Individualized instruction - The student is the focal point in the classroom. Responsibility for determining not only the rate at which they learn, but also a choice in determining the scope, sequence and material to be learned is given to the student.

Traditional or conventional instruction - The instructor is the central figure in the classroom, responsible for dispensing knowledge, at the same rate to all students. The teacher determines what material is to be covered and how it is to be learned.

New Science or Innovation Programs - Science programs developed since 1960 which stress the development of process, inquiry, individualization and problem solving.

Innovation user - Individual performing as a teacher or professor implementing innovations within an organizational context or classroom situation.

Change facilitator - Anyone responsible for assisting innovation users in implementing an innovation.

Components - The major features of an innovation. Components are usually either teacher behaviors, student activities, or how materials are used (Heck et al. 1981).

Decision Point - A judgement made by the developer to distinguish between different components and variations. Decision points are used to classify different types of implementation, or use from the developer's viewpoint, e.g., IDEAL use where all components are present with the developer's preferred variations, to ACCEPTABLE use, to UNACCEPTABLE use where components are present with unacceptable variations (Heck et al. 1981).

Innovation Configurations - The <u>operational</u> patterns of the innovation that result from implementation by different individuals in different contexts (Heck et al. 1981).

Variations - The different ways in which the components can be operationalized, e.g., ways in which users are actually using parts of the innovation--program materials, ways of grouping, approach to content. Components may be present or absent, e.g., bilingual teacher or no bilingual teacher (Heck et al. 1981).

Chapter 2

REVIEW OF LITERATURE

The Science Curriculum Evolution

To understand the ever-changing developments of science education today, it is essential to review some of the history that has lead to the present science classroom situation. Early school curricula had very little emphasis in science laboratory courses. Today, laboratory instruction is of major importance.

The period of time from the colonial days to the middle and late 1700's marked the time of virtually no science in the school curriculum except at the university level. With the public high schools emerging in the 1820's, most had incorporated science classes into their curriculum. The instruction resembled a catechism approach of the textbooks, where reading and listening about science occurred. Laboratory experimentation finally became evident after the Civil War.

Colleges had a significant impact on what and how sciences were being taught in the last part of the nineteenth century. This was largely due to the entrance requirements set forth by a higher learning institution (Collette, 1973, pp. 27-28). Brandwein (1958) writes of the time when courses in high schools were given over to "preparedness for college." The

time thereafter reflected a rash of science education changes.

The original purpose of science instruction was to train the mind primarily to assemble facts. Then, after the establishment of the junior high school, the emphasis included a more practical and less formalized approach. A general background in science with knowledge of how to apply concepts in science to everyday living problems was a major goal up until the World War II conflict.

After World War II and the launching of Sputnik (the first satellite in orbit) by the Russians in 1957, the training of future scientists became the object of much attention. Kahle (1979) writes of one possible root of the problem was failure of science teachers to stay abreast with scientific progress, "as shown by our students still classifying leaves and wildflowers, memorizing the periodic table, and reciting the laws of mechanics."

The shift from teaching students <u>about</u> science to preparing them to be scientists correlated with the shift of learning by aquisition of predetermined facts to the learning of the "processes" of science. The understanding of scientific principles and developing problem-solving abilities were stressed to a greater degree than in the past. Skills in gathering and testing data in problem-solving that would lead to the examining of past accepted conclusions were

strongly stressed as the aims of science education (Collette, 1973, p. 31). However, the teaching of scientific facts was not cast away. They were presented in a different context by teaching the "processing" of science.

The National Science Foundation

As was pointed out earlier, there was a growing national concern for science education from 1950 through the 1960's. With the attention, funds became available that could support large curriculum projects in science. The most noted source was the National Science Foundation (NSF), an independent Federal agency set up by Congress in 1950 with a mandate to develop a national policy for the promotion of basic research and education in the sciences. "NSF spent close to three hundred million dollars, as of 1965, on an investment in the science and mathematics knowledge of school teachers" (Krieghbaum and Rawson, 1969, p.4).

National curriculum groups used a large amount of funds to bring about changes and new approaches to the teaching of science up to 1965. "All of these approaches attempted to lead students through a series of experiences which encouraged the creative process and to bring them to a point where they conceptualized the scientific knowledge they obtained" (Collette, 1973, p. 33). Real investigations with students directly

involved with "discovery" and not just re-doing demonstrations, increased the anticipation and excitement of science learning. With these ideas incorporated into laboratory work, it was "hoped that the student will become scientifically literate in that he or she will have a better understanding of how and why scientists approach problems" (Marshall and Burkman, 1966, p. 10).

The Junior High School Curricula

Since the very beginning of junior high schools, there has been much confusion and debate over the functions and roles of these schools. With this instability even today, it adds to the problems that might exist in the ever-changing science curriculum for the middle school age student.

In the 1960's, the junior high school science program was probably the most neglected curriculum with the most poorly prepared teachers and inadequate facilities found in our public schools (Collette, 1973, p. 72). General Science dominated the junior high school science classes (1973, p. 76). Changes started occurring in the middle sixties and through the seventies but they were slow because of the different organizational patterns that existed, such as grades 6-8, 7-8, 7-9, etc. Development of unified common scope and sequence science programs are still scarce today.

However, the changes did reflect the "discovery and inquiry" emphasis that require the student to raise questions and use the science processes to find answers.

Students were given the opportunity to form hypothesis, observe, set up their own experiments, and draw conclusions from their results. The teacher was confronted with a very demanding role in that he or she must keep abreast with the new developments in science and the best teaching methods available for the individualized approach of teaching of science.

The Intermediate Science Curriculum Study

Intermediate Science Curriculum Study (ISCS) is an individualized seventh, eighth, and ninth grade science program centered around a laboratory and activity oriented approach. The ISCS program is characterized by the following overall rationale.

> (1) The fundamental assumption of ISCS is that science at the junior high school level should serve a general educational function for all students,
>
> (2) presumes that both the processes of scientific inquiry and the concepts of science are important and should be introduced together by allowing major concepts to arise out of investigations,
>
> (3) designed to allow the rate of instruction and the scope and sequence of content to vary with the individual students background, interest, ability, and,

> (4) to be activity-centered because of the project developers belief that junior high school students profit more by handling objects (Burkman, 1981, pp. T3-T4).

The ISCS Program consists of combined student texts and laboratory activities, and the accompanying laboratory apparatus. ISCS is a sequential three-year program. Each year's activities have "story-lines" organized around science concepts and the processes of scientific inquiry. The text material is divided into a core sequence that every student follows, and excursions that either provide enrichment activities for the more capable student, or remedial help for the less able student. Teacher material including teacher training modules and student self-evaluation activities are also provided. A separate response book has been prepared for student answers to questions, for recording data from laboratory activities, and for graphs and tables. In addition, standardized tests have been developed for use in measuring the understanding of concepts found in the text materials.

The general flow of content from grade seven to grade nine emphasizes both science concepts and the processes of science. The seventh-grade course (Level 1) is concerned with energy, its forms and characteristics and, measurement and operational definition. The student investigates the conversion of energy from one form to another, making realistic measurements wherever possible. Physics oriented activities

gradually shift to experiments introducing chemistry in the first level. The eighth-grade (Level 2) themes are matter and its composition and, model building. The student develops the Level 1 particle model and then applies it in interpreting physical, chemical, and biological situations in the laboratory and in nature. The flow of content is from chemically oriented activities to those resembling a biochemistry nature. The ninth grade course (Level 3) is interdisciplinary in nature using the techniques of investigation and experimentation as well as the science concepts that the student has learned earlier and applies that knowledge to subjects ranging from astronomy to genetics, and from health to geology (Burkman, 1981, p. T8).

As the students move through the three year program, they are given more freedom and thus more responsibility. "In this regard, Level 2 is intermediate between the relatively tightly structured approach taken in Level 1 and the more open-ended Level 3" (Burkman, 1970).

There are three characteristics of the ISCS classroom that make it different from a conventional or traditional classroom.

(1) The teacher's role is more that of advisor than instructor,

> (2) the pace, scope, and sequence of what is taught vary, depending upon the student's interest, ability, and background, and
>
> (3) the students are given primary responsibility for managing their own instructional time (Redfield, Rationale for Individualization, 1972, p. 4-3).

ISCS is convinced that the goal and design of instruction should be to meet realizable needs of every student.

ISCS attempts to develop a student's sense of responsibility by encouraging the students to discipline themselves to start to work as soon as class starts, to manage their own work time, try to figure out their own difficulties, and to determine when they need assistance from the teacher (Redfield, Individualizing Objective Testing, 1972, p. 3-2). "Ideally, the kind of evaluation process required should be characterized by the same elements of openness, freedom of choice, and personal responsibility for action" (Redfield, 1972, p. 3-2).

As pointed out earlier and also in the Your Students Role module, the student will gain more self-reliance if allowed to self-pace themselves. This means that the students will travel through the activities at their own speed (Redfield, 1973, p. 4-7). The project developers feel that the inability to provide for the self-paced approach is the greatest deficiency in present day education (Burkman, 1981, p. T4).

The experience of ISCS has shown that success with an activity-centered individualized science program depends heavily upon the willingness of the classroom teacher to

accept a new instructional philosophy and rationale. Of vital importance is the teacher's motivation and ability to adjust to and adopt organizational and instructional strategies that differ markedly from those characteristic of a teacher-centered program.

For most teachers, achieving an efficient and successful role transition depends on more than familiarity with a new student text, more than the availability of a teacher's edition, more than having a sympathetic administrator--though each of these is an asset. It depends upon an intensive and meaningful encounter with the unique features that characterize an individualized setting. This encounter should begin before the teacher is thrust into the new instructional role, and it should continue after the school year has begun.

The purpose of the ISCS Individualized Teacher Preparation (ITP) modular program was to provide a mechanism for meeting this encounter. The modular materials of the ITP were designed for in-service use by groups or individual teachers in a local school setting. The function of the modules is to facilitate and accelerate role transition by focusing on key organizational and instructional strategies and on areas of science content. The individualized format of the modules takes into consideration individual differences in teachers and is in keeping with the belief that teachers are most likely to teach in the same way as they have been taught.

The combined features of the modules resemble the ISCS student materials. They should aid in adapting to the ISCS teacher role and in becoming familiar with and better understanding the role of the student in an individualized learning situation. These modules were designed to aid in classroom organization, evaluation and grading, and similar areas (Redfield, 1972, foreward).

The Change Process

Society has always been confronted with the element of change. Change can provide a pressure that moves people to a state of uneasiness. Whether it be a change where there is a tendency to resist or to acclaim with hope the programs success, the potential of influence is heavy. Science education is effected by change in the form of new innovations or inventions developed by our universities, educational specialists and distinguished scientists. The new science programs of the 1960's promised to be the answer to our teaching woes. While many were successful, the adopting of a new program provides changes that become very difficult to assess, using standard measurement procedures, as to what the innovation has accomplished. The untested innovation, in its early development on paper, may not even seem like the same program when implemented into the classroom. Defining and measuring what innovation users actually are doing with that innovation becomes increasingly important. "Understanding what happens

to an innovation is important to those who implement a new program as well as for those who facilitate, evaluate, and make policy recommendations about the innovation" (Heck et al. 1981, p. 1).

While working at the Research and Development Center for Teacher Education at the University of Texas in a research project for innovation adoption, Hall and Loucks (1975, p. 52) found that "change" is not accomplished only because a "decision maker" decides to use the program accepts to implement the new program. More importantly, it is the type and degree of the use of the various parts an innovation, such as teachers and professors, that ultimately affect the innovation's success and failure rate. "One of the reasons for this variation is the commonly overlooked fact that innovation adoption is a process rather than a decision point--a process that each innovation user experiences individually" (1975, p. 52). This process is under the assumption that for it to be meaningful, it will no doubt take time--possibly years (Hall and Rutherford, 1976, p. 227). A basic assumption of the present research is that this variation in the degree of innovation adoption use by each individual innovation user must be behaviorally described and systematically accounted for if innovations are to be used with maximum effectiveness (Hall and Loucks, 1981, p. 52).

Different individuals using individual applications of an innovation then result in a high degree of variation.

Innovation configurations provide data about the operational patterns of the individual's use and degree of application of the respected innovation. Various patterns of use of the new innovation emerge, which represent the different contexts and teaching strategies employed by the innovation users. These patterns are called, by Heck, Innovation Configurations. The instrument designed to represent the parts of the innovation and variable degree of use of these parts is called an Innovation Configuration checklist or matrix (Heck, et al. 1981, p. 1).

A primary concern of teachers adopting or first using a new innovation is characterized by "what will be expected of me, the teacher." Understanding the philosophy behind the program is accomplished by the information about the components or basic elements describing the operational patterns of the innovation. The assessment of the application of the Innovation Configuration allows the "change process" to the new innovation a better understanding and facilitate a higher degree of successful effectiveness of the particular program being taught. This will help an innovation user to better implement a new program (Hall et al. 1975).

Other applications of Innovation Configurations can facilitate an evaluative approach, staff development activities, and/or applied in a research context. The evaluative approach can supply information describing whether the innovation has been fully implemented, the innovations characteristics after one or two years after adoption, and a comparison to

other programs. Staff development application could answer such questions as what teachers actually do to the different components of the Innovation Configurations. Being able to improve the strategies of use of the innovation would be a goal of the staff development application. In a research context, assessment to the actual degree of use and the modifications of their Innovation Configuration components can be compared to the "ideal" use of the same Innovation Configuration components as described by the initial innovation program developers.

The concern of this study does not exclude any of the above applications but rather includes a blend of concerns for all of the applications that might prove helpful in providing a better effectiveness of the teaching of the ISCS program.

The Concerns-Based Adoption Model

The Concerns-Based Adoption Model (CBAM) can facilitate the change process when applied to a new innovation program or to one that has "matured". The CBAM was originally proposed at the Texas Research and Development Center in 1973 (Hall, Wallace, and Dorsett). Research studies show that it has been helpful in understanding the nature and extent of implementation and how it can be facilitated. The National Institute of Education funded Procedures for Adopting Educational Innovations Project to research the different experiences and encounters

by teachers in schools and colleges as they adopt educational innovations (Hall and Rutherford, 1976, p. 228).

CBAM characterizes the implementation of an innovation as a systematic/adaptive/developmental process (Hall, Wallace, and Dorsett, 1973). Several studies of implementation have been completed since CBAM development began. Part of that development has included instruments that can be used for monitoring innovation implementation. The Stages of Concern Questionnaire (SoCQ) (Hall and Rutherford, 1976) and Levels of Use Interview (LoU) (Hall, Loucks, Rutherford, and Newlove, 1975), have been used to monitor the implementation process. Although LoU Interview and SoCQ cannot be termed as making the change process clear and simple, they do assist the change facilitators by giving them a framework to help develop anothers understanding of the innovation. The concepts and dimensions derived from LoU and SoC also help to evaluate change efforts and provide new types of research questions and policies.

Five basic assumptions undergird the CBAM. These include: (1) change is a process, not an event; (2) the understanding of the change process in organizations requires an understanding of what happens to individuals as they are involved in change; (3) for the individual, change is a highly personal experience; (4) for the individual, change entails developmental growth in terms of feelings about and skill in using the innovation; (5) information about the change process collected on an

ongoing basis can be used to facilitate the management and implementation of the change process (Heck, et al. 1981, pp. 7-8).

Stages of Concern

The Stages of Concern (SoC) refers to the concerns that individuals have when adopting or proceeding through a new innovation. Research literature including the research of Frances Fuller (1969) found there to be seven different stages of concern about an innovation. The findings of Frances Fuller indicate that the innovation users' initial concerns about use of an innovation seems to be egocentric. A typical initial reaction is how it will affect them personally and then what will the innovation demand of the user. Concerns about the management of the innovation becomes a high priority after use begins. Once the management concerns have become resolved, then users concerns tend to focus on how it affects the learning of pupils. These are referred to as impact concerns.

In order to achieve the "true implications" of moving from one stage concern to the next, a smooth developmental type of procedure is preferred. Based on their analysis of many different hierarchial theories, Phillips and Kelley (1975) have suggested that developmentalness is not a clear-cut phenomenon. The research would suggest that it applies to the concern development that innovation users go through too.

Brief definitions and the order of stages of concern about the innovation are listed and described below.

0) Awareness: Unconcerned about the innovation.

1) Informational: Concerns about general characteristics of the innovation and what is required to use it.

2) Personal: Concerns about one's role and possible conflicts between that role and anticipated demands of the innovation.

3) Management: Concerns about time, organizing, managing, and making the innovation work smoothly.

4) Consequence: Concerns about student outcomes.

5) Collaboration: Concerns about working with others in use of the innovation.

6) Refocusing: Concerns about finding another and even more effective way. (Hall and Rutherford, 1976, p. 229)

The use of the Stages of Concern model should help change facilitators or innovation users be aware of the kind of concerns that they might encounter. This would enable the selection of interventions that would assist users in moving from one concern stage to the next. The reduction of the trauma of change compliments the rewards accompanying a personal procedural development.

Levels of Innovation Use

The Levels of Use (LoU) concept provides information for the individual variations in use of an innovation. There are eight discrete levels that characterize an individuals' use of a particular innovation. "These levels range from lack of knowing that the innovation exists to an active, sophisticated, and highly effective use of it and, further, to active searching for a superseding innovation" (Hall and Loucks, 1975, p. 52). The LoU suggests that the stages--from spending most efforts, in the first or second year, in orienting and managing to integrating use of the innovation--is a developmental procedure. Obviously, an innovation user will probably not use a new program as effectively the first or second year as they would with more years of experience. These levels then characterize a user's development in acquiring new skills and varying use of the innovation. Each level

provides a range of behaviors but is limited by a set of identifiable decision points.

Before the innovation is first used, the user usually becomes familiar with and acquires knowledge about the innovation. The first time the individual uses the innovation there appears to be management problems that give the innovation a look of "confusion". After using the innovation for some time (possibly years), the management problems are resolved and managing becomes routine. Consequently the user (teacher or professor) can concentrate on providing more emphasis on the effectiveness of the innovation on the learners. The development flows to a state in which the user can integrate what s(he) knows with what possibly other colleagues know and then modify the existing innovation to fit the particular needs of the school. It should be noted that although years of use and experience are important, it does not ensure that a user will proceed through these levels year after year as it is a developmental growth procedure. Users may take longer or shorter lengths of time at the different stages of development.

The eight Levels of Use and Decision Points are summarized as follows:

Level 0) NON-USE: State in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.

Decision Point A: Takes action to learn more detailed information about the innovation.

Level I) ORIENTATION: State in which the user has recently acquired or is acquiring information about the innovation and/or has recently explored or is exploring its value orientation and its demands upon user and user system.

Decision Point B: Makes a decision to use the innovation by establishing a time to begin.

Level II) PREPARATION: State in which the user is preparing for first use of the innovation.

Decision Point C: Changes, if any, and use are dominated by user needs.

Level III) MECHANICAL USE: State in which the user focuses most effort on the short-term day to day use of the innovation with little time for reflection. Changes in the use are made more to meet user needs than client needs. The user is primarily engaged

in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.

Decision Point D-1: A routine pattern of use is established.

Level IV A) ROUTINE: Use of the innovation is established. Few if any changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.

Decision Point D-2: Changes use of the innovation based on formal or informal evaluation in order to increase client outcomes.

Level IV B) REFINEMENT: State in which the user varies the use of the innovation to increase the impact on clients within immediate sphere of influence. Variations are based on knowledge of both short and long-term consequences for clients.

Decision Point E: Initiates changes in use of innovation based on input of and in coordination with what colleagues are doing.

Level V) INTEGRATION: State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.

Decision Point F: Begins exploring alternatives to or major modifications of the innovation presently in use.

Level VI) RENEWAL: State in which the user re-evaluates the quality of use of the innovation, seeks major modification of alternatives to present innovation to achieved increased impact on clients, examines new developments in the field, and explore new goals for self and the system. (Hall, Loucks, Rutherford, and Newlove, 1975, p. 54)

By applying the Levels of Innovation Use model, it will be possible to assess individuals in terms of what level they are experiencing and consequently be able to provide help that will remedy the particular concerns about on innovation. Thus, the growth in use or development to the next level of the innovation will be facilitated and be less dramatic.

Innovation Configuration Development in the CBAM Model

The individual users of an innovation are the prime targets of the concepts of the Stages of Concern and Levels of Use models. Stages of Concern addresses the persons perceptions, feelings, and motivations relative to the innovation, while Levels of Use describes behaviorally how they are approaching use (Heck, Stiegelbauer, Hall, and Loucks, 1981, p. 8). The innovation itself is not focused on--that is, whether or not the innovation is really used. Innovation Configuration does address the innovations' true identity as performed in the actual classroom situation.

The Stages of Concern and Levels of Use models frequently referred to the experiences of users and non-users. Because of the ambiguous distinctions found to exist between the user and non-user state, minimum criteria had to be set up to distinguish them. These criteria would refer to the use of the various parts or components of the innovation. The

experience of defining minimum use then lent itself to the development of Innovation Configurations.

The innovation then was broken down into discrete parts which could be operationally defined. These parts or components are then developed into a checklist that the individual innovation users can easily check how they are using each of them. The data from this instrument can be used to assess the modifications or degree of implementation the innovation has undergone.

Research Relative to ISCS

Although not much research has been done that has followed up on the ISCS curriculum since its inception, there has been some work done that appears to be of particular importance to this study.

There are three studies that have been done that directly relate to the perceptions of preservice and/or beginning ISCS teachers and experienced teachers beginning the ISCS program.

Knight and Anderson (1975) performed a study that evaluated the use of ISCS classrooms as early experience sites for preservice science teachers and to examine the performance of the preservice teachers in the program. The preservice science teachers, though understanding the philosophy of the

ISCS program, exhibited modifications in their actual teaching experiences. Noted also was an increase in the number of preservice teachers preferring the junior high school for their teaching careers. The preservice teachers' interest in students' reading problems, in individualized instruction, and evaluation of students' progress increased after the early ISCS experience. The researcher concluded that the ISCS classroom is appropriate for an early experience in science teaching and does affect the preservice teachers' attitudes toward several dimensions of the program.

Another study which pertained to beginning ISCS teachers was done by McNair and Snyder (1974). The purpose of their study was to determine the extent to which beginning ISCS teachers implemented the major dimensions of the program in actual teaching practice. The major dimensions were: (1) managing equipment and materials, (2) evaluating individual student progress, (3) establishing classroom setting, and (4) individualizing instruction. Results showed that there was a significant difference evident between teachers. The ISCS project's ideas of strategic use of these major dimensions were performed to varying degrees by the novice ISCS teachers in actual classroom situations. Myers, (1971) searched to determine the extent to which the following five categories of ISCS were practiced by teachers as perceived by the students.

The five categories under investigation were: (1) the teachers' role, (2) the students' participation, (3) the textbook and its use, (4) laboratory preparation and, (5) laboratory participation of the students. Results showed that students thought their ISCS teachers were performing to meet the goals of the ISCS curriculum. The students also believed the textbook was being utilized as it is intended to be used and that laboratory experiences were being performed (including student participation and inquiry) as needed.

The individualized instructional system devised by ISCS puts a tremendous amount of pressure on the teacher to be able to perform on task. Because of the self-paced design, an ISCS classroom may well have up to twenty to thirty students each engaged in separate laboratory procedures. There may be as many as six to seven different chapters represented in a single classroom. The ISCS teacher needs to be able to respond appropriately to students' questions and problems with laboratory activities spontaneously. The ISCS program rationale suggests that the teacher's role be more of an advisor or facilitator allowing students to learn through investigations via the discovery learning experience. This opposes the traditional teacher role of being directive and leading the learning process which would be an impossible task in a self paced individualized classroom such as ISCS. The ISCS teacher

is faced with a type of teaching that is very frustrating and tiring, but extremely rewarding because of the more personable contact with the students.

Developing good personal relationships with students becomes important to a successful ISCS classroom. Powell and Voss (1974) reported that when the student controlled class time--that is when the teacher was in a supportive role and not working with the total class--accounted for 59 percent of the class period. This included the 40 percent of lab time and 19 percent of student talk and discussion. The results also showed the students liked the ISCS class more than previous science classes they had taken and that teachers and students felt there was good student-teacher rapport. Lauridsen (1972) supported the significance of teacher personality by finding that the ISCS students saw their teachers as being much warmer in their personal interactions. The findings, as noted by Lauridsen, suggest that the level of participation in the ISCS classrooms may have allowed the students to view their teachers from a different perspective, thereby enabling them to see their teachers as warmer people.

Being able to respond spontaneously to a very large variety of questions that might exist in a laboratory situation such as ISCS obviously requires the teacher to be very knowledgeable in the science content he/she is teaching. Clark (1975)

found that teacher knowledge of the process of science and the content taught through ISCS, were significantly related to pupil achievement. The ability of the teacher to ask questions via the inquiry approach to teaching and the non-verbal active behavior (moving all through the class supervising pupil activities rather than sitting alone at a desk or preparing equipment) was also reported by Clark to increase pupil achievement. Significant findings also called for the teacher to exhibit good instructional behaviors where the teacher "interacts" with pupils to clarify and/or expand their understanding of concepts and/or procedures rather than to discipline or to deal with classroom routines.

One of the very demanding roles of an ISCS teacher is in the area of grading the students. With the students in a self-paced, individualized mode of learning, the grading needs to be individualized too. In many traditional classrooms, the students grade is determined by his or her place in comparison to their classmates. The situation could and usually does exist where most of the pupils are at different places in the textbook or ISCS program, thus providing different "grading scales" may have to be implemented to accomodate the various conditions that emerge. In a study concerning ISCS grading, Martinez-Perez and Snyder (1973) found the mean teacher grading for ISCS students was significantly

lower than in the case of the non-ISCS teacher. "This may be the result of a more 'realistic' grading practice in the case of the ISCS teacher due, among others, to more interaction with students on a personal basis and a larger variety of assessment tools and opportunities."

ISCS requires a particular kind of attitude on the part of the student to be effective. Students evaluate their own progress, make decisions about pathways through the program, and decide how much they are going to do. ISCS students are on their own more often than in most classrooms. As far as the student is concerned, the big difference between the ISCS classroom situation and that of his other classes is the ISCS design "to allow the rate of instruction and the scope and sequence of content to vary with the individual student's background, interest, and ability" (Redfield, Your Students Role, 1973, p. 1-5).

Lauridsen (1972), along with doing a study on ISCS teacher personality traits, included in that study some research on the effectiveness of ISCS Level One with non-ISCS seventh grade science classes by employing a pretest-posttest nonequivalent control design. Some of the areas of comparison of the two groups were "1) fostering positive growth in the scientific attitudes associated with the nature of scientific laws, the limitations of science, and the desirability of science as a vocation; 2) enhancing the

self-reliance level of seventh grade students; 3) elevating the ranking seventh grade students give to science when they rank five classroom subjects in order of their preference."

Analysis of the findings were: 1) the ISCS group did undergo significant positive increases in attitudes toward science laws whereas the non-ISCS group did not experience as large a positive change; 2) the ISCS and non-ISCS group both experienced a negative change in attitude when associated with considering science as a vocation; 3) both groups had a slight positive increase in attitude for the limitations of sciences; 4) both groups ranked science lower, but not significantly, when considering preferential ranking of classroom subjects; 5) both groups experienced slight, but insignificant increases in self-reliance.

The ISCS program lends itself to mastery learning. The opportunities to perform laboratory experiments with specific directions and places to record observations and data are an integral part of the program. "Excursions" which consist of remedial work and enrichment exercises are provided too. The idea is for the student to work independently through the ISCS curriculum without specific directions from the teacher.

The ISCS publishers ideally consider the student to have free choice as to what they want to learn through the

course of this curriculum. Fletcher (1974) did some research on the effect of free choice on the mastery of ISCS objectives in the Level II program. Determining whether a student mastered an objective was done by completing performance checks and given a pretest-posttest over each objective. An attitude survey was also completed by each student. There were three groups tested. One included students that had free choice on all objectives to be tested, another group allowed students to choose half of the objectives to master while the other half were assigned by the teacher, and the third group consisted of students that were assigned all the objectives to be mastered.

The findings of the study showed that IQ correlated with mastery of objectives but there were no significant differences between each of the three groups. The attitude survey showed that a very significant number of students experienced a greater degree of self-reliance from the pretest to the posttest. Also, an overwhelming need expressed by the students was to know the objectives they were to master ahead of time.

Students work in ISCS classrooms at different rates. Some students may be as much as ten chapters ahead of others (DeRose, 1972). One of the major purposes of a study by Gabel and Herron (1977) was to examine the effect of allowing

students to pace themselves to achieve mastery learning versus imposing a deadline for completion of chapters in the seventh-grade ISCS program. In general, the results showed that higher learning rates and retention were evident among the self-paced group as opposed to the deadline-imposed group. Low ability children overwhelmingly achieved higher in a self-paced group opposed to a deadline-imposed group. When low ability children are given enough time to master an objective by allowing them to self-pace, they very successfully progressed even though the rate of learning was slower. "Whether a teacher, school, or school system adopts a self-paced mode for ISCS instruction depends on the capabilities and willingness of the personnel and the objectives of science teaching in the junior high school." Deadlines imposed on students demand that the students "cover" such number of chapters even though they may not have understood them sufficiently to master their content. The study seems to show that the "self-paced" students cover less chapters but achieve a higher degree of learning of more difficult concepts and acquire higher retention rates. In fact, Gabel and Herron found that the low ability students who were self-paced, learned at a faster rate than students on deadlines. To a classroom observer, this probably would not be apparent.

The choice of whether an ISCS science class to elect to go to a self-paced or "deadline" mode of learning depends on the junior high school science program objectives. If the objective is to focus on higher level concepts, then the self-paced mode to require mastery of one chapter before proceeding to the next is the best alternative. If the district's science program is to expose the junior high school science student to as many science concepts as possible, risking mastery, then the deadline approach is the choice preferred.

In addition to examining the effect of imposing deadlines versus allowing students to pace themselves, the effect of working by oneself or with a partner was studied by Gabel and Herron. A possible objective to an individualized learning program is to work alone at a proper learning rate speed. However, it can be argued that it may help a student to be exposed to the problem-solving and learning strategies of a partner. Also conceivable could be detriment to learning if the social interchange between partners shifts too much from science content to "social talk" unrelated to science.

Learning rate and retention as measures when working with a partner is different than compared to measuring whether a student works best self-paced or "deadline" imposed. Especially true for children working with a deadline, "if the teacher can control the partnership so that each student is working,

there appears to be an advantage, particularly for low-ability children, in working with a partner (Gabel and Herron, 1977)." The low-ability children were able to retain more of what they learned too and, usually, retention is thought of as a more valuable educational objective than learning rate.

A very important and sometimes determining factor imposed on any mode of teaching in a curriculum is money. How much money is budgeted to the science program is very important. The ability to allow students to work in groups or partnership quite naturally will lower the operating cost of the ISCS program.

Gabel and Herron's contributions seem to suggest that giving the students the opportunity to self-pace themselves and the choice to work with a partner will allow the students to give more attention to the science concepts and consequently enhance learning.

As noted earlier, ISCS is an individualized science program. Considerable debate has been and still is occurring over which is a better teaching strategy--group or individualized instructional techniques. James (1972, pp. 91-96) addressed this issue via a research project. An argument against the ISCS individualized approach is the speculation if junior high students can really accept the amount of responsibility given to them and achieve optimum learning in such a "free"

environment as dictated by ISCS. A very significant result found by James, as interpreted by this researcher, was "failure to find differences in the achievement between the two treatments (group or individualized) tends to support the idea that students in the individualized treatment are able to assume responsibility for their learning, and profit from an environment which has been judged by some observers as 'chaos' (p. 95)".

Successful implementation of the ISCS program depends on many factors including the district's commitment and teachers preparation for the program. Obviously there seems to be a number of choices that are determinant on other factors that need to be resolved. Every new school year, initially, students need guidance and a very large demand for the teacher to role play in the ISCS instructional mode as dictated by the school's goals is needed. Standards of achievement must be established for, rather than by students, in order to better equip the student with an atmosphere conducive to learning. The goal is to eventually mode the student into a more self-reliant figure shifting from external motivation to internal motivation (McDuffie and DeRose, 1982, p. 35-43).

Significantly influencing the successful implementation of ISCS is the teachers characteristics that are cognitive in nature: Knowledge of the process of science and knowledge

of the content of the ISCS curriculum. Further, the ISCS recommendations concerning teacher characteristics are valid and the pupil will achieve significantly in the ISCS course if they are followed in implementation (Clark, 1975).

Chapter 3

METHODS AND PROCEDURES

Introduction to Methods of the Study

As noted earlier, a large number of curricular programs were developed in the 1960's to teach the processes of science, develop scientific attitudes and interests, and an understanding of the relationship science has with the "real" world. However, merely developing new materials is not enough in a fully successful curriculum implementation. The success of a new program depends greatly on the teacher's perceived role concerning the curriculum (BSCS Newsletter 12, 1962, p. 1).

The laboratory based ISCS program allows the teacher the opportunity to modify the program to the school's needs. The large variety of possible teaching techniques and the number of schools using ISCS compromise a very significant population to study.

The Study Population

The population of this study consisted of Kansas ISCS teachers. The study was limited to Kansas teachers but no attempt was made to concentrate on any one region of the state. Names of schools using ISCS were obtained by writing

to the Silver Burdett regional salesman of the ISCS textbook and materials. Addresses and telephone numbers of the schools were obtained from the Kansas State High School Activities Association publication. The possible schools using ISCS were contacted by telephone. After explaining the research study, the principal and/or science consultant was asked to supply the names of the teachers in the school using ISCS and for his or her permission to send them the instrument that would be used as data in the research. The instrument was sent and time was allowed for response; then follow-up letters with extra questionnaires were sent to non-respondents.

The intent of this study was to include all ISCS teachers in Kansas. This was accomplished except for one large district which declined to participate. Fifty-seven instruments were sent out to ISCS instructors, and forty-seven replied for an approximate eighty-two percent return.

Instrumentation

A questionnaire was developed by the researcher that consisted of two parts. One part was analytical (IC) and another demographic. The analytical portion of the questionnaire gathered information regarding the nature and extent of use of ISCS. Demographic information collected included years teaching experience in ISCS and in what level(s) and also any training they have had to prepare them for teaching ISCS.

The analytical part consisted of an eleven item ISCS Innovation Configuration Checklist that was developed by the researcher. Good clarity and format are essential to a successful checklist. Some of the points of consideration were:

1) Number of components (ten is ideal).

2) Number of variations (do not overburden the user with too many choices or not enough).

3) Component labels (should be descriptive, capturing the essence of the behaviors or activities included under the components).

4) Language used in component(s) variations (should capture the essence of the developers intent while remaining intelligible to the users).

(Heck, Stiegelbauer, Hall, and Loucks, 1981, p. 40).

The initial version of the instrument was developed after examining the ISCS Teacher Training Modules, and program objectives as revealed in the literature. Eleven program conponents consisting of teacher behavior, student behaviors and learning activities were identified. Probable variations as to how each is operationalized in the classroom were specified and ordered according to the researcher's arbitrary judgment as to whether the variations were ideal, acceptable or not acceptable. Ideal variations were those judged to be

most nearly consistent with the developer's intent. The ideal variations were listed first and the unacceptable ones last. The initial checklist was then sent to four proven science educators who facilitated or taught ISCS and also five experienced ISCS teachers to receive feedback from them for purposes of refinement.

A special demographics sheet was prepared to identify experienced or beginning ISCS teachers. Questions asked of the respondent were:

1) Number of years teaching ISCS and what level(s)?

2) How many sections of each level are you currently teaching?

3) Describe the training that you have had to teach ISCS?

4) Have the ISCS Teacher Training materials been used and if so, have they been helpful and how?

5) What levels and number of other sections of ISCS are being taught in the building?

6) What modifications or changes have you made in ISCS?

Validation of the Instrument

The researcher validated the instrument through consultation with four ISCS teacher/facilitators who were also professors of science teacher education. Each was familiar with ISCS and CBAM Techniques. They were asked to read the questionnaires and comment on content validity and the clarity of the items. Those components and variations that were seen as redundant or confusing were either eliminated or modified. Also, these four professors suggested additional components and variations. The revised copy of the instrument was field tested by five active ISCS instructors. Their recommendations for changes were noted. No attempt was made to establish the reliability in the instrument.

Final copies of the instrument were sent to ISCS teachers with instructions to reply at their earliest convenience. A self-addressed stamped envelope was included to further convenience the ease of reply.

Chapter 4

RESULTS

The results of the demographic and configuration study are presented in this chapter. As pointed out earlier, this study was made to present the degree of implementation of major components in the ISCS program. The individualization factor of ISCS allows the teacher to have an influence upon the degree of instruction presented to the pupils. Data on the eleven components or variations were analyzed.

Demographic Data

The results of the demographic part of the study is described and tabulated beginning with table 4.10. The instrument was completed by the study population in April of 1984, and consequently the 1983-84 school year was counted as a year taught. The results of the basic demographic study are summarized in table 4.10.

Table 4.10

Basic Demographic Data by ISCS Levels

	Level I	Level II	Level III
average number of years experience teaching ISCS	7.5	7.3	6.4
number of teachers teaching	24	23	6
average number of sections taught per day by each respondent in their respective level	3.6	4.1	2.7
average number of _other_ sections of ISCS taught by other teachers in their building	6.9	6.5	5.5

The range of years experience teaching ISCS by the study population was sixteen to one. The average number of years experience teaching ISCS was approximately 7.1. Table 4.10 indicates a substantially larger number of teachers are teaching Levels I and II in contrast to Level III. In their respective ISCS levels of teaching, a respondent taught per school day an average of 3.6 sections of Level I, 4.1 sections of Level II, and 2.7 sections of Level III. If _other_ levels of ISCS were represented in the school, there was a per school day average of 6.9 sections of Level I, 6.5 sections of Level II, and 5.5 sections of Level III being taught.

Table 4.11 presents data about ISCS training and shows that there were a large proportion of teachers with no training in teaching ISCS. A majority (59%) of teachers have had less than ten hours of training to teach the ISCS program.

Table 4.11

Amount of Training to Teach ISCS

Hours of training to teach ISCS	Number of teachers	% (approx.)
0	17	36
1 - 9	11	23
10 - 39	2	4
40 +	17	36

As indicated in table 4.11, the majority (63%) of respondents have some training. Table 4.12 presents data regarding the type of training reported by these teachers. Some (30%) attended college workshops and 20% attended summer institutes offered at various colleges. One teacher had attended a six week study at Florida State University during the initial development stages of ISCS.

Table 4.12

Type of Training to Teach ISCS

Type of training to teach ISCS	Number of teachers	%
College workshop (NSF or other)	9	30
Summer Institutes (various colleges)	6	20
College classes	4	13
Only Teacher Training Materials	2	7
Six week Institute (Florida State University)	1	3
Other	8	27

One of the questions asked of the study population was their knowledge of the ISCS Teacher Training Materials. Data in table 4.13 provides information about teacher reaction to these ISCS Teacher Training Materials which indicates 38% of the teachers had not used the Teacher Training Materials to prepare them to teach ISCS. Teachers were asked whether they were aware of and used the materials, were they helpful and how. Of the twenty-eight teachers that had read and used the ISCS Teacher Training Materials, twenty (71%) described them as being helpful. Twenty-nine percent did not think they were very valuable in helping them operate the ISCS program. The area that the training materials did prove to be most helpful to teachers was in management and organization of the ISCS program (59%). Seven (31%) teachers noted that they helped them understand ISCS philosophy and two (10%) used them for evaluation of their science program.

Table 4.13

Usefulness of the ISCS Teacher Training Materials

	Number of teachers	% (approx.)
Have read and used ISCS Teacher Training Materials	28	62
Not used ISCS Teacher Training Materials	17	38
ISCS Teacher Training Materials helpful	20	71
ISCS Teacher Training Materials	8	29
Used for Management and Organization Purposes	13	59
Used to Understand ISCS Philosophy	7	31
Used for Program Evaluation Purposes	2	10

One of the questions asked of the study population was the modifications or changes that they made to the ISCS program. There generally appear to be modifications made to the ISCS program to fit the individual needs of the students or teachers. Table 4.14 indicates there were three modifications mentioned most by ISCS teachers: 1) Enriching the ISCS program with other supplemental materials, 2) various pacing standards set by the teacher, and 3) using and requiring different parts of the textbook at different times. In every case, except two, where a teacher made a modification it was determined as successful by that teacher.

Table 4.14

Demographic Study on the Areas of Modification of ISCS

Areas of Modification and Addition to the ISCS Program	Number of teachers	% (approx.)
Enriched with other supplemental materials	16	26
Various pacing of student work	15	25
Requiring and Sequencing different parts of the textbook	12	20
Lab experiments	5	8
Uses of supplies and equipment	3	5
Grouping of students	3	5
Tests	3	5
Class discussion	3	5
Recording of data	1	1

<u>Results of the Configuration Study</u>

A comparison of implementation of the eleven components of ISCS is presented in this section. The table 4.15 presents the percentages of the study population using each component variation. As noted earlier, the ISCS checklist was formated to allow comparison of actual implementation to some ideal use specified by the researcher. This checklist presents the variations in the order "ideal, acceptable, and unacceptable" (Heck, Stiegelbauer, 1981, p. 39).

The study population chose the ideal and acceptable variation(s) most of the time, indicating that ISCS is being operated in an acceptable manner. In approximately half the components, the acceptable variations were chosen over the ideal variations. The acceptable variations are modifications to the "ideal" use of the program as determined by the researcher. This would indicate possibly that ISCS is being modified to tailor to specific needs of a particular ISCS classroom.

A significant exception exists in component number nine (on the pacing of student work) in that the unacceptable variation was marked by approximately a quarter of the study population. In component number three (the use of tests), approximately thirty-nine percent of the study population used only teacher-made tests for written evaluation measurements.

Table 4.15

ISCS Innovation Configuration Results

Directions: Complete the following items by checking the blank opposite the choice which most nearly describes your present use of ISCS.

%

1. Use of ISCS Natural World textbook or Modules.
   - 43 Only ISCS textbook or Modules are used.
   - 57 Combination of ISCS textbook or Modules are used and supplemental textbooks are used.
   - 0 ISCS textbook or Modules are not used. Other textbooks are used.
   - 0 Textbooks not used.

2. Use of ISCS Natural World Record (workbook) book.
   - 57 Only ISCS Record book used.
   - 21 Combination of ISCS Record book and other workbooks or data-collecting books used.
   - 13 ISCS Record book not used; other workbook or data-collecting books used.
   - 9 No Data-collecting or Record-keeping books are used.

3. Tests.
   - 4 Only ISCS developed tests are used.
   - 16 ISCS developed tests are used with revisions.
   - 41 Sometimes ISCS developed tests used as well as some teacher-made tests.
   - 39 Only teacher-made tests used.
   - 0 Tests are not used.

4. Use of self-evaluations as described in ISCS Natural World Record book.
   - 66 Used as described by ISCS teacher guides.
   - 19 Used only when teacher thinks valuable.
   - 6 Not used, but teacher-made worksheets for self-evaluation are used.
   - 9 No self-evaluations are used.

5. Use of excursions (enrichment, remedial, techniques) in the ISCS Natural World book.
   - 0 Students are allowed to choose excursions according to their interests.
   - 98 Some excursions are required by the teacher and some are chosen by students according to their interests.
   - 0 No excursions used, but other enrichment, remedial, and/or technique sources are used.
   - 2 No enrichment, remedial, or technique sources are used.

6. Use of ISCS Equipment and Supplies.
   - 67 Supplies and equipment used as described in teacher's guide.
   - 25 Use of ISCS equipment and supplies is variable according to its availability
   - 8 Alternative equipment and supplies are selected by teacher.
   - 0 Neither equipment nor supplies are used.

7. Setting up of groups.
   - 13 Students decide on group membership.
   - 69 Students decide group membership, but teacher redirects group membership as needed.
   - 14 Teacher decides on group membership.
   - 4 Students do not work in groups.

8. Number of students per group.
   - 12 In general, students work alone and not in groups.
   - 82 In general, Students work in groups of two or three.
   - 6 In general, students work in groups of four or more.

9. Pacing of student work.
   - 6 Completely self-paced with no minimum or maximum limits.
   - 35 Self-pacing with minimum limits set by the teacher and dictated by student's ability.
   - 35 Self-pacing minimum limits set by the teacher.
   - 24 Lock-step pacing with minimum requirements per grading period.

10. Teacher role during learning activity.
    - 58 Teacher usually acts as advisor or facilitator, giving minimal direction.
    - 38 Teacher is sometimes facilitative (30% or more of time) and sometimes directive (30% or more of time)
    - 4 Teacher is usually directive: leading the learning process.

11. Student role during learning activity.
    - 88 Students active; making decisions, performing hands-on activities, and recording data.
    - 10 Students sometimes active in the learning process.
    - 2 Students usually non-active; writing, watching, and listening to teacher-directed lesson.

Ideal-First Variation
Unacceptable-Last Variation
Acceptable-Variation(s) between the ideal and unacceptable
*Exception-component 7 has all acceptable variations

Individual Component Details

The most obvious feature provided by component number one on the use of textbooks is that the ISCS textbook is being used in various degrees in the program. In over half the ISCS classrooms (57%), the ISCS textbook is supplemented with other textbooks. Also noted is that forty-three percent of the ISCS programs were run with only the ISCS textbook.

Component number two in the use of a record or workbook indicates that more than half of the study population uses the ISCS Natural World Record Book. The results show that ISCS teachers value the ability to record data and especially in an ISCS Record book. Perhaps a surprising figure in a lab oriented class is that approximately nine percent of the ISCS classrooms do not even use data or record-keeping books.

The use of tests component yielded several important results. First, only four percent of the study population uses only the ISCS developed tests which might indicate short comings in the tests provided by the developers. Second, the majority of the testing involved revisions made to ISCS developed tests or supplemented with teacher-made tests. Third, and as noted earlier, thirty-nine percent of the ISCS teachers make up their own tests. Fourth, every ISCS classroom used tests indicating the need of a written measurement device to evaluate student progress. Possible explanations to the desire to modify or use teacher-made tests could be: 1) ISCS tests are bad, 2) too hard, and 3) they do not measure teacher goals.

A large majority of the study population (66%) uses self-evaluations as described by ISCS teacher guides. Since the self-evaluations are included in the Natural World Record Book, this is not too surprising as it would be very convenient for the students to perform. Perhaps important too, though, is that approximately twenty percent of the teachers use the self-evaluations only when thought of as valuable. This indicates that although the location of the self-evaluations is easily accessible, some teachers question the value of them. One teacher specifically noted that since the answers are provided to self-check, many students merely copied the answers without putting much thought in truly trying to answer the questions themselves.

Approximately the whole study population (98%) required some excursions (enrichment, remedial, and techniques) and allowed the students to choose some excursions according to their interests. Allowing the student sole responsibility to choose their own excursions appeared to be a luxury for the students that would not work effectively.

"Ideal" use of equipment and supplies was agreed with sixty-seven percent of the study population. Approximately a quarter of the teachers surveyed use the equipment and supplies according to their availability. This possibly indicates the expense of the ISCS program and the school's ability to cope with this very important curriculum

factor. Since the ISCS program is an activity or lab oriented class that requires the use of ISCS equipment and supplies, there obviously were not respondents using the program without these necessities.

Although ISCS is an individualized program, one of the goals is for students to develop abilities to work with partners and share responsibilities of setting up a laboratory experiment and performing the tasks involved. Generally, the developers of ISCS intended the students to work alone and in certain experiments to have a partner help. However, the results of this study indicate that generally students always work in at least groups of two or three. Eighty-two percent of the ISCS classrooms indicate this group orientation. Very few classrooms (6%) allow the groups to exceed three numbers to a group. Possible explanations to the results might be reflecting the expense of the ISCS program again. Obviously, grouping of students doing labs will cut costs of the operation of the program. The most immediate factors of not letting the groups get too large is temptation of the students to talk about other subjects besides science and perhaps more important--not enough responsibility to be shared by each member of the group. The larger the group, the greater the tendency to do a lot of "watching" and not enough "doing".

Component number nine addressed the issue of pacing of student work. Ideally, ISCS would have the program be completely self-paced allowing the students to progress at their own speed with no minimum or maximum limits. However, in actual practice only six percent of the ISCS classrooms employ this method. Self-pacing with some minimum limits tends to be the favorable method of operating the program. A significant portion (approximately a quarter of the study population) employs the "lock-step" method where all the students are doing the same thing at the same time. A possible reason for the implementation of minimum standards and the "lock-step" method might be that generally the student's earlier classes in other disciplines as well as science use the mode of instruction where everyone is at the same place. Therefore, it is sometimes very difficult for a student to come into a class where they are "programmed" to want to know what it is they have to do and in what allotment of time they have to achieve that particular goal. Definitely though, lock-step pacing is not a goal by the ISCS developers. Lock-step pacing seems to be a method made to convenience the teacher rather than the student. Minimal limits seem to be an acceptable compromise method by the majority of the study population without affecting the self-pacing mode to the extremity of lock-step learning.

The teacher role during learning activities of ISCS indicates that the study population tends to agree with the developers to be largely facilitative and not directing the learning process.

An important characteristic of ISCS is for the students to be very active, doing hands-on activities, and learning via the discovery approach. A very significant number (88%) of the ISCS classrooms follow this approach making it a very integral characteristic to the success of the program.

After carefully studying component number seven on the setting up of groups, this researcher realizes this was not a specific component of the ISCS program. The variations existing in this component could all be acceptable in the operation of ISCS. Indeed, the setting up of groups is important to laboratory operations, but is more of a general teaching method than an integral component of ISCS. Therefore, component number seven has no direct influence on this investigation, and is presented only as a matter of interest.

Chapter 5

CONCLUSIONS

Purpose

In the past, science classes were passive indicating the teacher directed the learning process and the student listened and perhaps took notes. The pacing was "lock-step" so all the students were at the same place in the learning lesson. Later, studies tended to support the theory that an active learner will learn better than one who is passive (Jensen, 1975). Science programs were encouraged to be activity-centered and require a hands-on involvement on the part of the student. The trend in curriculum development in the seventies was to involve the student to a much greater degree than in the past. The emergence of the "alphabet soup" science programs opened up a new approach to teach science (Rowe, 1982, pp. 63-64). Intermediate Science Curriculum Study followed this trend to an activity-oriented and hands-on approach. ISCS utilized individualized instruction to develop the individual in science as a major goal.

Individualized instruction not only means a change in the role of the student but also a change in the teacher's role of instruction. Few efforts were made to evaluate the implementation of science programs. In particular, there

is scant information about the nature and extent of implementation of ISCS. The purpose of this study was to assess how Kansas ISCS teachers are using the various components of the program and in general to assess the overall picture of ISCS implementation.

The instrument used in this research was developed to be easily distributed to ISCS teachers. The demographic and configuration checklist segments of the questionnaire could be completed by the teacher in a minimal amount of time. The purpose of this study was to collect and analyze the data regarding present use of the ISCS program by Kansas teachers.

Conclusions

The conclusions of this study were:

1. Analysis of the data indicated the majority of the teachers were teaching ISCS according to the ideal specifications set forth by the researcher for five of the components. They were as follows.

    a. Use of the Natural World Record Book (workbook).
    b. Use of self-evaluations as described in the ISCS Natural World Record Book.
    c. Use of equipment and supplies.
    d. Teacher role during learning activity.
    e. Student role during learning activity.

2. Analysis of the data indicated a majority of the teachers were using ISCS in an <u>acceptable</u> style of teaching in the remaining six components. They are as follows.

   a. Use of ISCS <u>Natural World</u> textbook or modules.

   b. Tests.

   c. Use of Excursions (enrichment, remedial, techniques) in the ISCS <u>Natural World Book</u>.

   d. Setting up of groups.

   e. Number of students per group.

   f. Pacing of student work.

3. The data indicated the ISCS program was either being supplemented with other materials or was the supplemental program itself existing with another curriculum.

4. The very large number of teachers using their own tests in the ISCS program showed how tests vary in complexity by being based on individual teaching and learning goals as set by the participating school.

5. Allowing the students full responsibility of choosing their own excursions did not seem a choice for the teachers of ISCS. The ability to first require

some excursions and allow the students to choose others was the overwhelming style of teaching in this component.

6. The most significant result of data that seemed to contradict ISCS philosophy was the number of ISCS classes taught with lock-step pacing. It is this researchers view that those classrooms might be taught in that style for the reason it is easier, thus making a more "smoothly running program". The demographics showed that some of the respondents using this mode of pacing included both experienced and inexperienced teachers. The demographic study reported the experienced teachers used "lock-step" pacing because basically when they employed self-pacing they felt many of their students wanted to do as little as possible. The beginning teachers used it as a means of "survival".

7. The overall analysis of the data indicate that ISCS was being taught in Kansas in an acceptable manner in the view of the philosophy and goals set forth by the developers of ISCS.

8. When a program is first developed and implemented, it is usually modified by the teacher. This research indicates that there was a high degree of modification occurring to ISCS in the actual classroom. The trend seems to be that teachers are moving farther and farther away from the original ISCS program. Some ISCS classrooms may contrast with the "ideal" version to such a great extent that there may not be much resemblence between them.

Recommendations for Further Research

The findings of this investigation were concerned with the overall implementation of the major components of ISCS. The study was also limited to Kansas ISCS teachers but did try to include all of the ISCS teachers possible.

The next logical research would be to investigate separate individual components of ISCS by providing a statistical analysis of outcomes on the learning achieved by students on the variations of using the ISCS components. Extending the research out geographically to include other states is, of course, a very valid area to study too.

Individualization offers many areas that continually need to be researched. Some of these include discipline, classroom management, teaching styles, learning styles, reading ability and learning disability students in science classrooms, frustration, grading, and examinations.

Recently the number of classrooms using ISCS has been declining. Attempts should be made to study why this trend is occurring and what the future of ISCS entails.

The ISCS Innovation Configuration Checklist should be used by ISCS facilitators to monitor the implementation of the program and direct interventions at improving implementation.

Since the ISCS Innovation Configuration Checklist describes the operational patterns of the innovation, information about the components can complement teacher understanding of the philosophy behind the program, thus allowing teachers to envision what will be expeted of them. In an evaluation context for the ISCS program, information can be used to answer questions such as whether ISCS has been fully implemented, what ISCS looks like one or more years after adoption, and what relationship ISCS has to student or other intended outcomes. Staff development activities can be planned according to the results of the ISCS Configuration Checklist. In service programs could be provided to modify, complement, or change current practices of participating teachers. For example, if research showed that students who kept their own records did better on tests, then a workshop could be presented to look at the relationship of student records to students outcomes.

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Appendix A

ISCS Innovation Configuration Checklist

by Robert K. James and

Stephen E. Holaday

Directions: Complete the following items by checking the blank opposite the choice which most nearly describes your present use of ISCS.

1. Use of ISCS Natural World textbook or Modules.

    _____ Only ISCS textbook or Modules are used.

    _____ Combination of ISCS textbook or Modules are used and supplemental textbooks are used.

    _____ ISCS textbook or Modules are not used. Other textbooks are used.

    _____ Textbooks not used.

2. Use of ISCS Natural World Record (workbook) Book.

    _____ Only ISCS Record book used.

    _____ Combination of ISCS Record book and other workbooks or data-collecting books used.

    _____ ISCS Record book not used; other workbook or data-collecting books used.

    _____ No Data-collecting or Record-keeping books are used.

3. Tests.

    _____ Only ISCS developed tests are used.

    _____ ISCS developed tests are used with revisions.

_____ Sometimes ISCS developed tests used as well as some teacher-made tests.

_____ Only teacher-made tests used.

_____ Tests are not used.

4. Use of self-evaluations as described in ISCS Natural World Record Book.

_____ Used as described by ISCS teacher guides.

_____ Used only when teacher thinks valuable.

_____ Not used, but teacher-made worksheets for self-evaluation are used.

_____ No self-evaluations are used.

5. Use of Excursions (enrichment, remedial, techniques) in the ISCS Natural World Book.

_____ Students are allowed to choose excursions according to their interests.

_____ Some excursions are required by the teacher and some are chosen by students according to their interests.

_____ No excursions used, but other enrichment, remedial, and/or technique sources are used.

_____ No enrichment, remedial, or technique sources are used.

6. Use of ISCS Equipment and Supplies.

_____ Supplies and equipment used as described in teacher's guide.

_____ Use of ISCS equipment and supplies is variable according to its availability.

_____ Alternative equipment and supplies are selected by teacher.

_____ Neither equipment nor supplies are used.

7. Setting up of groups.

_____ Students decide on group membership.

_____ Students decide group membership, but teacher redirects group membership as needed.

_____ Teacher decides on group membership.

_____ Students do not work in groups.

8. Number of students per group.

_____ In general, students work alone and not in groups.

_____ In general, students work in groups of two or three.

_____ In general, students work in groups of four or more.

9. Pacing of student work.

_____ Completely self-paced with no minimum or maximum limits.

_____ Self-pacing with minimum limits set by the teacher and dictated by student's ability.

_____ Self-pacing minimum limits set by the teacher.

_____ Lock-step pacing with minimum requirements per grading period.

10. Teacher role during learning activity.

_____ Teacher <u>usually</u> acts as advisor or facilitator, giving minimal direction.

_____ Teacher is sometimes facilitative (30% or more of time) and sometimes directive (30% or more of time).

_____ Teacher is usually directive; leading the learning process.

11. Student role during learning activity.

_____ Students active; making decisions, performing hands-on activities, and recording data.

_____ Students sometimes active in the learning process.

_____ Students usually non-active; writing, watching, and listening to teacher-directed lesson.

Appendix B

Demographics Sheet

1. Indicate the number of years teaching ISCS and level by providing the number(s) in the following blanks.

   I ________

   II ________

   III ________

2. Level(s) of ISCS you are currently teaching.

   I ________

   II ________

   III ________

3. Number of sections of each level of ISCS you are currently teaching.

   I ________

   II ________

   III ________

4. Describe the training you have had to prepare you to teach ISCS (estimate number of hours trained).

5. What modifications or changes have you made in ISCS?

   How successful were they?

6. Number of other sections of ISCS being taught in your building.

   I ________

   II ________

   III ________

7. Have you read or used any of the ISCS Teacher Training materials?

   (circle) yes no

If yes, were they helpful? (circle) yes no

If yes, describe how they helped you.

A STUDY OF IMPLEMENTATION OF THE
INTERMEDIATE SCIENCE CURRICULUM STUDY
IN KANSAS

by

STEPHEN EDWARD HOLADAY

B. S., Kansas State University, 1981

AN ABSTRACT OF A MASTER'S THESIS

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Observers of the educational scene seem to agree that innovations in education are temporary at best with most teachers never using the adopted program. The literature reveals little about the nature of implementation of science programs in general and implementation of Intermediate Science Curriculum Study (ISCS) in particular. ISCS is an individualized, activity-oriented, laboratory based, science program designed for the junior high school.

The purpose of this study was to assess how ISCS teachers in Kansas were using the program components and to assess the overall picture of implementation in relation to demographic data, teacher training and years of use.

The Research and Development Center for Teacher Education at the University of Texas at Austin has developed strategies for monitoring implementation of new programs. Innovation Configuration was developed to assess how teachers operationalize program components. This strategy involves developing a two-way matrix of program components versus the spectrum of ways each component might be observed to be operationalized in classrooms (variations).

The ISCS Innovation Configuration Checklist was developed by the researcher. Eleven components with 3 to 5 variations were rated at "ideal," "acceptable," or "not acceptable," according to the perceived intent of the developer. Four ISCS teachers/facilitators critiqued the initial version of the instrument providing suggestions for improving content validity and format. Five ISCS teachers field tested the final version. The eleven components were: textbooks; record books; tests; self-evaluations; excursions; equipment and supplies; grouping; number per group; pacing students; teacher; and student role.

The instrument was mailed to 57 ISCS teachers and 47 returned it (82%). Analysis of the data generally indicated that teachers were using the components in an "acceptable," or "ideal" manner. However, data on self pacing showed 24% of the teachers used lock step pacing which was "not acceptable." Teachers usually make their own tests and supplement the basic text with other material.

It is recommended future research be directed at examining relationships between individual component/variations and student outcomes. The ISCS Innovation Configuration Checklist should be used by ISCS facilitators to monitor the implementation of the program and direct interventions at improving implementation.